AMENDMENTS
(Amendments under Article 11)

To the Examiner of Patent Office

1. Identity of the International Patent
PCT/JP03/10219

2. Applicant

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4. Subject of Amendments
Specification and Claims

5. Contents of Amendments
(1) Wording "and mass average molecular weight of 5000 to 40000" is added by an amendment between the wordings "acid value of 50 to 300" and "having" of claim 1.
(2) Corresponding to the amendment of claim 1, the wording "wherein the styrene acrylic type resin has a mass average molecular weight of 5000 to 40000" of claim 2 is deleted by an amendment.
(3) Corresponding to the amendment of claim 1, the wording "and mass average molecular weight of 5000 to 40000" is added by an amendment between the wordings "acid value of 50 to 300" and "having", on page 5, in line 11 of the specification.
(4) "Japanese Unexamined Patent Application, First Publication No.H10-88042" on page 2, in line 20 of the specification is amended to read "Japanese Unexamined Patent Application, First Publication No. 2002-256201".
(5) "Japanese Unexamined Patent Application, First Publication No. H08-183920" on page 3, in line 7 of the specification is amended to read "Japanese Unexamined Patent Application, First Publication No. H10-88042".
(6) The wording "(for example, see Japanese Unexamined Patent Application, First Publication No.2002-256201 official report (Examples))" on page 3, in lines 9 to 10 of the specification is deleted.

6. Attachments
(1) Pages 37and 38 of Claims (which correspond to pages 53 to 54 of the English text)
(2) Pages 2, 3, and 4 of the Specification (which correspond to pages 3 to 6 of the English text)

CLAIMS

1.(Amended) A process for producing an aqueous pigment dispersion for ink-jet recording, comprising a first step of kneading (1) a styrene-acrylic type resin with a styrene type monomer unit of 50 to 90 mass %, and at least one unit selected from an acrylic monomer unit and a methacrylic monomer unit, having an acid value of 50 to 300 and a mass average molecular weight of 5,000 to 40,000, (2) a pigment, (3) a basic compound, and (4) a humectant to produce a solid colored kneaded product, and a second step of dispersing the solid colored kneaded product in an aqueous medium comprising water or water and a humectant.

2. (Amended) The process for producing an aqueous pigment dispersion for ink-jet recording as set forth in claim 1, wherein the (2) pigment is at least one pigment selected from the group consisting of an azo type yellow pigment, a quinacridone type red pigment, a phthalocyanine type indigo blue pigment, and a carbon black type black pigment.

3. The process for producing an aqueous pigment dispersion for ink-jet recording as set forth in claim 2, wherein the mass percentage of the (1) styrene-acrylic type resin, the (2) pigment, and the (4) humectant in the first step is (1) 10 to 100 parts, (2) 100 parts, and (4) 20 to 100 parts, repectively.

4. The process for producing an aqueous pigment dispersion for ink-jet recording as set forth in any one of claims 1 to 3, wherein the kneading in the first step is performed using a planetary type kneading apparatus.

5. The process for producing an aqueous pigment dispersion for ink-jet recording as set forth in claim 4, wherein the kneading temperature in the first step is not higher than a glass transition temperature of the (1) styrene-acrylic type resin.

6. The process for producing an aqueous pigment dispersion for ink-jet recording as set forth in any one of claims 1 to 3, wherein the (3) basic compound is an alkali metal hydroxide, and the (4) humectant is a polyhydric alcohol having a boiling point of not less than 170°C.

7. The process for producing an aqueous pigment dispersion for ink-jet recording as set forth in any one of claims 1 to 3, wherein the compounding amount of the (3) basic compound is an amount corresponding to 0.8 to 1.2 times the amount for neutralizing all carboxylic groups of the (1) styrene-acrylic type resin.

8. An aqueous ink for ink-jet recording comprising the aqueous pigment dispersion as set forth in any one of claims 1 to 3 as a main component.

9. The aqueous ink for ink-jet recording as set forth in claim 8 which is used for ink-jet recording in a thermal ink-jet type.

dispersions is proposed (for example, see Japanese Unexamined Patent Application, First Publication No.2001-262038(page 234)).

However, the step of producing aqueous pigment dispersions using a sand mill is generally performed using a dispersed liquid of low viscosity having a small percentage of solid content such as a pigment, etc. Accordingly, a strong sharing force is hardly applied to pigments, thereby it takes a long time to crush large pigment particles.

Moreover, aqueous pigment dispersions thus obtained contain a considerable amount of large particles having a particle size of not less than 1 μm even after being dispersed. And since the jetting stability of the ink-jet cannot be secured in this state, it is necessary to perform a further step of removing these coarse particles using centrifugation, filtration, etc., and as a result, there is a problem in that production efficiency and yield further decrease.

In addition, the applicant produced aqueous pigment dispersions in which carbon black was dispersed, using a resin having a weight average molecular weight of 7200 with the resin composition disclosed in the above patent official report 1, by a method using a paint shaker, which uses beads similarly to a sand mill (for example, see Japanese Unexamined Patent Application, First Publication No.2002-256201(claims, Examples)). According to this production method for aqueous pigment dispersions, it is possible to produce an aqueous ink for ink-jet recording which has a fine particle size and excellent dispersing stability, and the ink jetting performance is also excellent. However, in the case in which this production method is applied to azo pigments or quinacridone pigments which are generally difficult to be dispersed, the dispersing performance is not as good as that of carbon black. Moreover, since this method is only suitable for small scale production, it is not possible to perform mass-production of the aqueous pigment dispersions efficiently.

On the other hand, a method is known which includes kneading a mixture of a resin and pigment or a mixture of an aqueous resin solution which contains a resin, water, and a water-soluble organic solvent and pigment through rolls, before the dispersing step is performed. In a twin-roll, a process is performed which includes kneading the above mixture to produce solid chips, then adding mainly water and a water-soluble organic solvent to the resultant chips, and then dispersing the mixture using a high-speed mixer or a homogenizer, etc., to obtain aqueous pigment dispersions(for example, see Japanese Unexamined Patent Application, First Publication No.H6-157954 (pages 2, 3, 5 and 6) and Japanese Unexamined Patent Application, First Publication No.2000-80299 (pages 2 and 3)).

In addition, adding an organic amine in order to make production of a resin solution easy is also performed (for example, see Japanese Unexamined Patent Application, First Publication No.2001-81390 (page 5)).

For example, aqueous pigment dispersions are produced through a kneading process by a twin-roll, using a styrene-acrylic type resin having a weight average molecular weight of 50000 and the resin composition disclosed in Japanese Unexamined Patent Application, First Publication No.H10-88042.

If such a method is used, then pigments are subjected to a shearing force between the rolls to be finely crushed, however, since open type kneading is actually performed, water and water-soluble organic solvent evaporate in the kneading step, thereby finally forming solid chips having a high solid content percentage. And as a result, in the subsequent step, it is necessary to perform crushing and dissolving of the solid chips and dispersing of pigments by adding water and a water-soluble organic solvent.

Accordingly, this burdens the dispersing step subsequent to the step of kneading with rolls, and as a result, there is possibility that dispersing time may be prolonged, or,

even if dispersing is performed for a long time, large particles may remain. Moreover, the solid chips after being kneaded between the rolls is processed to the dispersing step in which the solid chips is crushed and dissolved in this way, and hence even if the surface of the pigment is coated with resin, the resin coating on the surface of pigment after production of the aqueous pigment dispersions may not necessarily be sufficient.

Moreover, in the kneading step using the twin-rolls, the kneaded material should be shaped into a sheet between the rolls in the kneading step and the kneaded material should not be eliminated from the rolls. For this reason, there is a possibility that the raw material, pigment, resin, water, water-soluble organic solvent, etc., and blending percentage thereof may be restricted, because there is a problem in that the colored kneaded product may not successfully become uniform, depending on the thermal characteristic of the resin , and on blending percentage of the raw material.

DISCLOSURE OF INVENTION

The present invention was made in view of the above circumstances, and it is an object of the present invention to provide a process for producing aqueous pigment dispersions for ink-jet recording in which fine pigments are stably dispersed and such a state can be maintained for a long period of storing.

Moreover, it is another object of the present invention to provide a process for producing aqueous pigment dispersions for ink-jet recording in which the time required for production such as dispersing time is short, and the production efficiency is high.

The inventors of the present invention found that the above objects of the present invention can be attained by kneading the following four components of a solid resin having the specific structure, pigment, a humectant, and a basic compound with a large

shearing force to produce a solid colored kneaded product, and thereafter dispersing the colored kneaded product in an aqueous medium. The present invention was perfected based on this new technological finding.

That is, the present invention provides a process for producing an aqueous pigment dispersion for ink-jet recording, comprising a first step of kneading (1) a styrene-acrylic type resin with styrene type monomer unit of 50 to 90 mass %, and at least one unit selected from an acrylic monomer unit and methacrylic monomer unit, having an acid value of 50 to 300 and a mass average molecular weight of 5,000 to 40,000, (2) a pigment, (3) a basic compound, and (4) a humectant to produce a solid colored kneaded product, and a second step of dispersing the solid colored kneaded product in an aqueous medium comprising water or water and humectant.

And further, the present invention provides an aqueous ink for ink-jet recording which is obtained by diluting further the aqueous pigment dispersions for ink-jet recording produced using the above-mentioned process with an aqueous medium, and if necessary adding various additives.

According to the production process of the present invention, since the four components of the styrene-acrylic type resin, the pigment, the humectant, and the basic compound are kneaded with a large shearing force in the first step, the pigment is crushed into a fine powder, and simultaneously the styrene-acrylic type resin which is imparted with water dispersibility in the presence of the basic compound is absorbed efficiently to the surface of the fine pigment, such that the surface of pigment is coated therewith. In particular, since the styrene-acrylic type resin used in the present invention contains 50 to 90 mass % of high-concentration styrene type monomer unit, it excels in absorbability to the hydrophobic pigment surface, such that encapsulating of pigment by the resin is likely